

5

tion. As shown, a multiplexer 120 communicates across a bi-directional line. Multiplexer 120 is connected to an optical regulator 122 which is connected to another multiplexer 124. Multiplexer 124 is also connected to a second optical regulator 122, as shown. An optical amplifier 126 receives a signal from multiplexer 124 and provides an amplified signal to a multiplexer 128. Multiplexer 128, in turn provides signals to a multiplexer 130 as well as multiplexer 120. As shown, the use of optical regulators 122 according to the present invention allows balancing of the power levels at bi-directional line amplifiers using a single amplifier 126.

FIG. 6 is a block diagram of one embodiment of a wavelength division multiplexed system, 140, with end-to-end channel power control feedback according to the present invention. System 140 is similar to system 40 of FIG. 2. However, optical regulators 50 of FIG. 2 are shown as optical monitors 142. Note that the detector 62 in the optical regulator can be used for the optical monitor 142. Further, microprocessor controller 52 is linked to microprocessor controller 48 by a data communication link 144. The link provided by data communication link 144 allows feedback from one end point to the other concerning the channel power control provided by optical regulators 46 and optical monitors 142. This data communication link is typically provided by an optical supervisory channel that is integrated into the optical communication system.

Although the present invention has been described in detail, it should be understood that various substitutions, changes and alterations can be made hereto without departing from the spirit and scope of the invention as defined by the appended claims.

What is claimed is:

1. An optical channel regulator, comprising:

- an electrically variable optical attenuator receiving an optical signal, the attenuator operating to attenuate the optical signal responsive to a feedback control signal and to provide an attenuated optical signal;
- a tapped optical coupler receiving the attenuated optical signal of the attenuator, the optical coupler operating to provide substantially all of the attenuated optical signal as an output and to provide a remaining portion of the attenuated optical signal as a tapped output;
- an optical detector receiving the tapped output and providing an electrical signal representing the attenuated optical signal; and
- a comparator receiving the electrical signal of the optical detector and a reference signal, the comparator operating to compare the electrical signal, the reference signal, and responsive to the comparison to provide the feedback control signal to the attenuator.

2. The optical channel regulator of claim 1 further comprising:

- a second tapped optical coupler receiving an input optical signal, the second tapped optical coupler providing substantially all of the input optical signal as the optical signal received by the electrically variable optical attenuator and providing a remaining portion of the input optical signal as a tapped output; and
- a second optical detector receiving the tapped output from the second tapped optical coupler and providing an electrical signal representing the input optical signal.

3. An optical regulator assembly comprising:

- a plurality of optical channel regulators, each optical channel regulator comprising:
 - an electrically variable optical attenuator;
 - a tapped optical coupler;

6

- an optical detector; and
- a comparator; and

4. a microprocessor, operable to:

- receive the electrical signal representing the attenuated optical signal from each of the plurality of optical channel regulators;
- generate a plurality of reference signals responsive to the electrical signals; and
- provide a reference signal to the comparator in each of the plurality of optical channel regulators.

4. The optical channel regulator of claim 3, wherein each optical channel regulator further comprises:

- a second tapped optical coupler receiving an input optical signal, the second tapped optical coupler providing substantially all of the input optical signal as the optical signal received by the electrically variable optical attenuator and providing a remaining portion of the input optical signal as a tapped output; and

- a second optical detector receiving the tapped output from the second tapped optical coupler and providing an electrical signal representing the input optical signal.

5. An optical channel regulator assembly comprising:

- a plurality of optical channel regulators, each optical channel regulator comprising:
 - an electrically variable optical attenuator;
 - a tapped optical coupler;
 - an optical detector; and
 - a comparator; and

a microprocessor, operable to:

- receive the electrical signal representing the input optical signal from each of the plurality of optical channel regulators;
- generate a plurality of reference signals responsive to the electrical signals; and
- provide a reference signal to the comparator in each of the plurality of optical channel regulators.

6. The optical channel regulator of claim 5, wherein each optical channel regulator further comprises:

- a second tapped optical coupler receiving an input optical signal, the second tapped optical coupler providing substantially all of the input optical signal as the optical signal received by the electrically variable optical attenuator and providing a remaining portion of the input optical signal as a tapped output; and

- a second optical detector receiving the tapped output from the second tapped optical coupler and providing an electrical signal representing the input optical signal.

7. A multiple channel wavelength division multiplexed communication system comprising:

- a plurality of transmission channels;
- a plurality of optical regulators operable to receive a plurality of optical signals from said plurality of transmission channels, each optical regulator comprising:
 - an electrically variable optical attenuator;
 - a tapped optical coupler;
 - an optical detector; and
 - a comparator;

a first microprocessor, operable to:

- receive an electrical signal representing the attenuated optical signal from each of the plurality of optical regulators;
- generate a plurality of reference signals responsive to the electrical signals; and
- provide a reference signal to the comparator in each of the plurality of optical regulators;

7

an optical combiner operable to receive a plurality of said attenuated signals;

a first optical amplifier operable to receive an output signal from said optical combiner;

a second optical amplifier operable to receive an output signal from said first optical amplifier;

a third optical amplifier operable to receive an output signal from said second optical amplifier;

an optical demultiplexer operable to receive an output signal from said third optical amplifier and recover said plurality of optical signals;

a plurality of optical regulators operable to receive a plurality of optical signals from said optical demultiplexer, each optical regulator comprising:

- an electrically variable optical attenuator;
- a tapped optical coupler;
- an optical detector; and
- a comparator;

a second microprocessor, operable to:

- receive the electrical signal representing the input optical signal from each of the plurality of optical regulators;

8

generate a plurality of reference signals responsive to the electrical signals; and

provide a reference signal to the comparator in each of the plurality of optical regulators; and

a plurality of receive channels operable to receive a plurality of optical signals from said plurality of optical regulators.

8. The optical channel regulator of claim 7, wherein each optical channel regulator further comprises:

- a second tapped-optical coupler receiving an input optical signal, the second tapped optical coupler providing substantially all of the input optical signal as the optical signal received by the electrically variable optical attenuator and providing a remaining portion of the input optical signal as a tapped output; and
- a second optical detector receiving the tapped output from the second tapped optical coupler and providing an electrical signal representing the input optical signal.

* * * * *